

CLAIMS

1. A curable silicone resin having the empirical formula
$$(R_3SiO_{1/2})_a(R_2SiO_{2/2})_b(RSiO_{3/2})_c(SiO_{4/2})_d$$
wherein each R is a hydrocarbon or substituted hydrocarbon group or a hydrogen atom; and  $a = 0.02$  to  $0.8$ ;  $b = 0$  to  $0.4$ ; and  $c+d = 0.2$  to  $0.98$ , where  $a+b+c+d=1.0$ , characterized in that at least 2 mole% of the siloxane units in the resin are of the formula  $R'_3SiO_{1/2}$ ,  $RR'_2SiO_{1/2}$  or  $R'_2SiO_{2/2}$ , wherein each  $R'$  is an alkenyl group.
2. A curable silicone resin according to Claim 1, characterized in that each  $R'$  is a vinyl group.
3. A curable silicone resin according to Claim 2, characterized in that at least 10 mole% of the siloxane units of the resin are  $Vi_3SiO_{1/2}$  groups, where  $Vi$  represents vinyl.
4. A curable silicone resin according to any of Claims 1 to 3, characterized in that at least 80 mole% of the siloxane units of the resin are selected from  $R'_3SiO_{1/2}$ ,  $RSiO_{3/2}$  and  $SiO_{4/2}$  units.
5. A curable silicone resin according to any of Claims 1 to 4, characterized in that at least 20 mole% of the siloxane units of the resin are  $ArSiO_{3/2}$  units where  $Ar$  represents an aryl group.
6. A self-curable silicone resin according to any of Claims 1 to 5, characterized in that 10-50 mole% of the siloxane units of the resin are  $HSiO_{3/2}$  units.

7. A self-curable silicone resin according to any of Claims 1 to 5, characterized in that 10-50 mole% of the siloxane units of the resin are  $\text{HR}_2\text{SiO}_{1/2}$ ,  $\text{H}_2\text{RSiO}_{1/2}$  or  $\text{HRSiO}_{2/2}$  units.
8. A curable resin composition comprising (I) a curable silicone resin according to any of Claims 1 to 5 and (II) a curing agent having at least one group reactive with the alkenyl group  $\text{R}'$ .
9. A curable resin composition according to Claim 8 characterised in that the curing agent contains at least one Si-H group and the composition includes a catalyst containing a platinum group metal.
10. A curable resin composition according to Claim 9 characterised in that the curing agent is a polysiloxane containing at least two Si-H groups or an aryl compound of the formula  $\text{HX}_2\text{Si-Ar-SiX}_2\text{H}$ , in which Ar is a substantially nonflexible linkage including at least one para-arylene moiety and each R is a hydrocarbon or substituted hydrocarbon group or a hydrogen atom.
11. A curable resin composition comprising a self-curable resin according to Claim 6 or Claim 7 and a catalyst containing a platinum group metal.
12. A process for the preparation of a cured heat resistant silicone resin having a low coefficient of thermal expansion, characterised in that a curable silicone resin according to any of Claims 1 to 5 is reacted with a curing agent having at least one functional group reactive with the alkenyl group  $\text{R}'$ .
13. A process according to Claim 12, characterised in that the curing agent contains at least one Si-H group and the curing process is carried out in the presence of a catalyst containing a platinum group metal.

14. A process for the preparation of a cured heat resistant silicone resin having a low coefficient of thermal expansion, characterised in that a self-curable silicone resin according to Claim 6 or Claim 7 is heated in the presence of a catalyst containing a platinum group metal.
15. A process for encapsulating a substrate, characterised in the substrate is encapsulated in a curable silicone resin composition according to any of Claims 8 to 11 and the resin is cured by a process according to any of Claims 12 to 14.
16. A process for coating a substrate, characterised in that the curable silicone resin according to any of Claims 8 to 11 is applied as a thin film to a substrate before being cured by a process according to any of Claims 12 to 14.
17. A process for making a composite material, characterised in that at least one layer of fibrous material is impregnated with a curable silicone resin composition according to any of Claims 8 to 11 and the resin is cured by a process according to any of Claims 12 to 14.
18. A process according to any of Claims 12 to 17, characterised in that the curing process comprises a first step at a temperature in the range 50 to 300°C and a subsequent heat cure step at a higher temperature in the range 300 to 500°C
19. A process according to Claim 18, characterized in that the further heating step at 300-500°C is carried out in the presence of an amine which is in the vapour state at the temperature of the further heating step.
20. A process according to Claim 19, characterized in that the amine is a tertiary amine of the formula  $NZ_3$ , where each Z represents an alkyl group having 1 to 4 carbon atoms.

21. A cured heat resistant silicone resin composition prepared by the process of any of Claims 12 to 20.